soaked in glycerine and water since its removal from the intestine, it still assumes, when not prevented by pressure, the same position by the elasticity of its body. If swallowed alive it would most probably have died and have suffered partial digestion before it had reached the lower part of the ileum. Furthermore, the intestine of the worm is filled with a reddish substance like the remains of blood; and we know that the Bats of the genus to which its host belongs feed partially on the blood of smaller species of Bats; so that, even if the worm is not a true parasite, it is very probably a messmate.

I have much pleasure in connecting with the specific title of this very interesting form the name of Dr. Macdonald, whose valuable researches have so largely contributed to our knowledge of the zoology of the Invertebrata.

LIV.—*On the Minute Structure of the Recent* Heteropora neozelanica, *Busk, and on the Relations of the Genus* Heteropora *to* Monticulipora. By H. Alleyne Nicholson, M.D., D.Sc., F.R.S.E.

[Continued from p. 339.]

Part II.

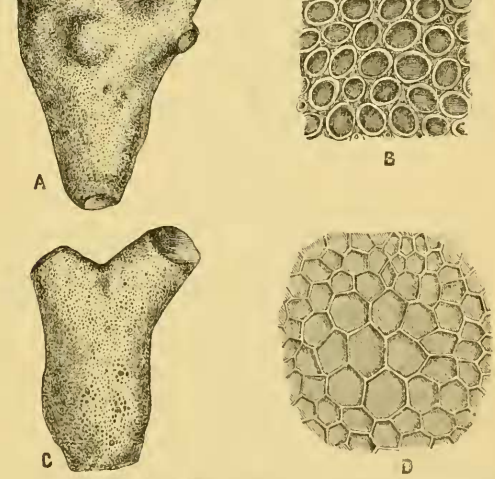
Having now considered the structure of the skeleton of a recent species of *Heteropora*, we may pass on next to consider the conformation of the corallum in *Monticulipora*, and may, finally, come to some conclusion as to the extent to which the two may be regarded as really similar to one another. That there exists a general resemblance between the ramose or dendroid forms of *Monticulipora* (using the term in its wide sense) and the species of *Heteropora* is undeniable and has long been known. Both consist, as regards their skeleton, of fasciculate tubes, which are nearly vertical in the centre of the branches, but which sooner or later bend outwards to reach the surface, becoming thickened, or otherwise structurally altered, in the latter part of their course. Nor is there any difference in size, either as regards the skeleton as a whole or the component tubes, which would prevent us comparing the two; while in both we have the remarkable feature that the skeleton is composed (except in a few Monticuliporids) of tubes which are not all alike, but which clearly differ, either in size or in some other character, from one another. It becomes therefore a matter of interest to discover how far this external resemblance is accompanied by an agreement in internal structure; and it is obvious that in investigating this point it is

desirable not only to select specimens which are externally similar in shape and figure, but also to compare a series of sections cut from precisely corresponding regions in both groups of examples. In order to fulfil these conditions I have chosen, in the first place, the Lower-Silurian *Monticulipora Jamesi*, Nich., which presents a close external resemblance to *Heteropora neozelanica*, Busk; and after briefly describing the external and internal features of this, I shall give a short account of the characters of *Monticulipora pulchella*, E. & H., in which we have a type of *Monticulipora* at least subgenerically distinct from *M. Jamesi*. I shall finally place together in a summary form the characters in which *Heteropora* and *Monticulipora* agree and those in which they differ.

Monticulipora Jamesi, Nich.

The corallum in this species of *Monticulipora* (fig. 3, A) is dendroid, the branches varying from about $\frac{1}{5}$ up to $\frac{1}{2}$ inch in

Fig. 3.



A. Part of the corallum of *Monticulipora Jamesi*, Nich., of the natural size. B. Part of the surface of the same, enlarged; from the Cincinnati group of Ohio. C. Part of a typical specimen of *Monticulipora pulchella*, Edw. & H., from the Wenlock Limestone of Dudley, of the natural size. D. Part of the surface of the same, embracing one of the clusters of large corallites, enlarged.

diameter, dividing dichotomously, terminating in rounded free ends, and sometimes becoming palmate by partial fusion.

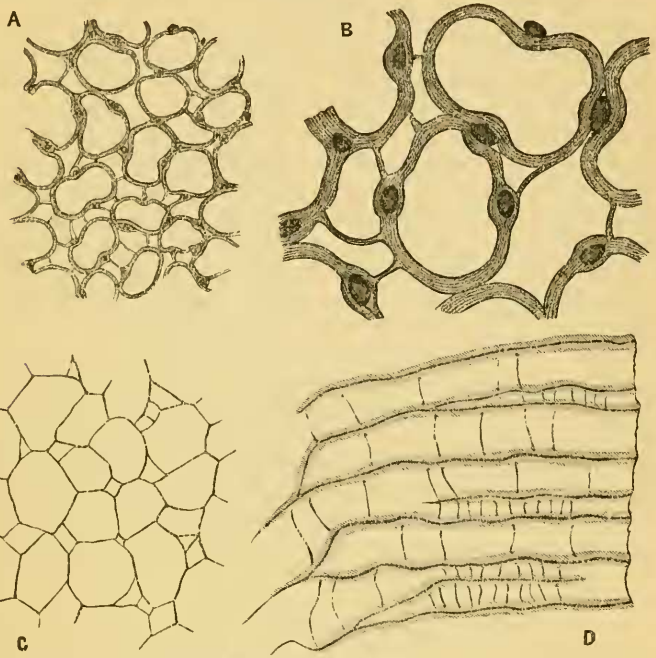
The surface in well-preserved specimens exhibits the apertures of the ordinary corallites, interspersed with numerous smaller openings, some of the latter being exceedingly minute; but in their more ordinary state of preservation the mouths of the smaller tubes can only be made out with difficulty or not at all. In any case, the larger corallites are rounded in form, and their mouths are encircled by thickened walls. The general appearance of the surface is thus very similar to that of *Heteropora neozelanica*, except that the small tubes are disproportionately minute as compared with the larger ones. We shall see also that the small tubes differ from the "interstitial tubes" of *Heteropora* in having a special internal structure unlike that of the ordinary corallites. With regard to the internal structure of *Monticulipora Jamesi*, we shall briefly examine the same three sets of sections as have been described in the case of *Heteropora*.

(a) *Tangential sections.*—These (fig. 4, A & B) exhibit the rounded or oval apertures of the larger corallites, which occupy the greater part of the section. Mixed up with these, at all their angles of junction, are numerous smaller corallites, which differ from the larger tubes both in size and in their very irregular though mostly angular shape. Lastly, placed at the angles of junction of the tubes previously mentioned, or intercalated in the wall between two contiguous corallites, we observe a great number of dark rounded bodies, which are the cross sections of a series of strong but really hollow tubes with thick walls and an exceedingly small central cavity. These "spiniform corallites," as I have elsewhere termed them, may be with considerable probability regarded as representing a series of rudimentary or specially modified corallites; and they form a peculiar and characteristic feature in many *Monticuliporæ*; but I cannot discuss their nature in this place. The walls of the tubes, as seen in sections of this nature, are thickened; but the line of demarcation between the walls of contiguous corallites is always distinctly recognizable, except occasionally in the boundaries between some of the smaller tubes. Lastly, it is to be noted that there are absolutely no traces of any canal-system in the walls of the corallites, or of any pores which might place the visceral chambers in communication with one another; nor can we discover the slightest indication of any thing of the nature of radiating septal spines or lamellæ.

(b) *Transverse sections* show centrally (as already pointed out in the case of *Heteropora*) the transversely divided tubes of the *axis* of the branch, while marginally they exhibit the tubes of the exterior thickened zone cut nearly longitudinally,

thus resembling in this region the outer portion of longitudinal sections. The only point to notice about these sections is

Fig. 4.



Thin sections of *Monticulipora Jamesi*, Nich. A. Part of a *tangential* section, taken just below the surface, enlarged eighteen times, showing the large and small corallites and the interspersed spiniform corallites. B. Part of the same section, enlarged fifty times. C. Part of a *transverse* section of a branch, in the *axial* region, enlarged eighteen times, showing the thin-walled, polygonal, and unequal-sized corallites of this part of the corallum. D. Part of a *longitudinal* section in the median plane, showing the corallites in the *outer* portion of their course, where their walls are thickened. The section shows the larger and smaller corallites, the former with remote, and the latter with close-set, tabulæ. From the Cincinnati group, Ohio.

that in their central portion we find the axial corallites to be polygonal in shape, and to be bounded by very thin and delicate walls (fig. 4, C), which, as before, are wholly imperforate. There is also now a total absence of the smaller interstitial corallites, these latter being confined to the exterior zone of the branches, and not extending into the deeper parts of the corallum.

(c) *Longitudinal sections* show different characters according to the precise point at which they are examined. In

their central portions we have the longitudinally divided corallites of the axis of the branch, which are here provided with very thin walls, and are nearly vertical in direction. Their cavities in this region are also intersected by but a very small number of "tabulæ," though these structures are present in small amount. In the outer part of longitudinal sections (as in the peripheral portions of transverse sections) we can study the characters of the tubes in their external thickened region, where they have become bent outwards on their way towards the surface (fig. 4, D). In this part of their course the walls of the corallites have become considerably thickened, though there is never any difficulty in recognizing the line of demarcation between the proper investment of any one tube and that of its neighbours. No indications are visible of any canals or pores placing the cavities of contiguous tubes in communication; but the visceral chambers are traversed by numerous complete and well-developed transverse partitions, or "tabulæ," which continue to be developed till close upon the actual mouths of the tubes. Between the larger corallites we can now also readily distinguish the smaller interstitial corallites, which can be at once distinguished, not only by their more diminutive size, but likewise by the distinct structural character that they are provided with more numerous and closely set "tabulæ" than is the case with the normal tubes.

*Monticulipora pulchella**, Edw. & Haime.

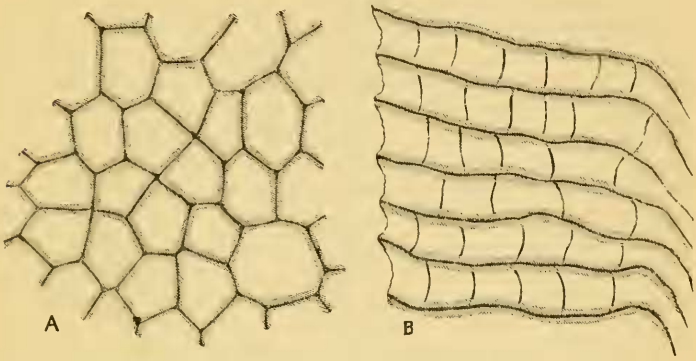
As there are considerable differences (differences of at least subgeneric, possibly of generic, value) between the various forms usually included by palæontologists under the common name of *Monticulipora*, I have thought it advisable to give here a short description of the structure of a type of the genus markedly distinct from *M. Jamesi*, Nich.; and for this purpose I have selected the well-known *M. pulchella*, E. & H., of the Upper Silurian deposits of Britain.

The typical *M. pulchella*, E. & H., as regards its shape and general appearance (fig. 3, C), is very similar to *Heteropora neozelanica*, Busk, except that the mouths of the tubes

* It may be noted here that the form which I have described from the Lower Silurian rocks of North America under the name of *Chætetes pulchellus* (Pal. Ohio, vol. ii. p. 195, and Quart. Journ. Geol. Soc. vol. xxx. p. 503) is not, as I have now ascertained, the same as *Monticulipora pulchella*, E. & H. It very closely resembles the true *M. pulchella* in external characters, and especially in the possession of clusters of large tubes interspersed at intervals among the average corallites of the corallum; but I find its internal structure to be such as to entirely separate it from the British species.

are regularly polygonal and thin-walled. Moreover, in place of large tubes mixed up singly in great numbers with smaller

Fig. 5.



Thin sections of a typical example of *Monticulipora pulchella*, E. & H., from the Wenlock Limestone of Dudley. A. Part of a *tangential* section, enlarged eighteen times, not passing through one of the groups of larger corallites. B. Part of a longitudinal section, enlarged eighteen times. Both sections show that the *wall* of the tubes has the same structure as is characteristic of *Favosites*; and the latter exhibits the remote tabulæ which intersect the cavities of the tubes.

tubes, we have *clusters* of large corallites (fig. 3, D) interspersed at short intervals in a general basis of smaller corallites. In the two points just alluded to, *M. pulchella* similarly differs from such a form of *Monticulipora* as *M. Jamesi*. In other respects, however, its general conformation and plan of structure are the same.

As regards the *internal structure* of *M. pulchella*, E. & H. (fig. 5), we find a much greater simplicity than exists in *M. Jamesi*. Thus in *tangential* sections (fig. 5, A) the corallites are seen to be regularly polygonal, with moderately but by no means excessively thickened walls, and showing no trace whatever of radiating spines or "septa." The structure of the wall, moreover, is entirely different from that of many Monticuliporids, and agrees precisely with what we find to exist in *Favosites*. That is to say, each tube is provided with its own calcareous investment, which remains permanently distinct. Hence the wall which separates any two contiguous tubes is always composed of two distinct calcareous laminæ, separated by a dark and definite boundary-line which is thickened at the points where three or more tubes come into contact. There are no very minute tubes, nor any "spiniform corallites;" and the dimorphism of the corallum is shown only by the presence at intervals of groups or clusters of corallites

of a larger size than the average. These large tubes, however, possess no special peculiarities of structure to distinguish them.

In *longitudinal* sections of *M. pulchella* the corallites are seen to be thin-walled, gradually thickening as they approach the surface, the boundary-lines between contiguous tubes being, in the outer part of their course, quite clearly marked. The cavities of the tubes are crossed by remote and complete tabulæ, which continue to be developed till close upon the surface; and there is no difference observable in the tabulation of the clusters of large tubes as compared with that of the ordinary corallites. There are no traces, either in longitudinal or tangential sections, of any canals or pores traversing the walls of the tubes or placing the visceral chambers of contiguous corallites in direct communication.

General Conclusions.

Finally, in instituting a comparison between *Heteropora* and *Monticulipora*, we may briefly review the following points:—

(1) As to the general *form* of the corallum, the two genera are very similar, though this point is of itself wholly without significance, and the latter genus comprises types of very varied shape and mode of growth. If, however, we compare *Heteropora* with the ordinary dendroid types of *Monticulipora*, we have in both a corallum made up of slender fasciculate tubes, which are nearly vertical in the centre of the branches, and then curve outwards, gently or abruptly, to reach the surface. In both, therefore, there are established two distinct regions of the corallum, an axial and a peripheral region. In both, moreover, these two regions are very different in internal structure, the tubes in the axial region of their course being thin-walled and polygonal, while in the peripheral region their walls are thickened, and they often become more or less rounded in form. In both, further, it would appear that any special interstitial tubes that may be present are developed in the peripheral region only, and extend either not at all, or to a very limited extent, into the axial part of the corallum.

(2) As regards the *dimorphism* of the corallum, all the most characteristic and typical species of *Monticulipora* consist of at least two, and sometimes of three, distinct sets of tubes, which generally differ both in size and in internal structure, and which are differently arranged in different cases. In *Heteropora* the skeleton consists of a series of large tubes surrounded by smaller interstitial tubes; but it does not appear that there is any special difference in the *internal structure* of

these. In neither genus are we acquainted with the *soft parts*; and therefore we cannot assert positively that this dimorphism has precisely the same significance in the two genera, while there are grounds for thinking that the reverse is the case.

(3) As regards the structure of the *wall*, the visceral cavities of the tubes of *Monticulipora* appear to be always closed, no traces of any pores or canals in the wall having yet been clearly proved to exist. In the case of *Heteropora*, on the other hand, the thickened walls of the tubes, in the peripheral part of their course, are traversed by an exceedingly well-developed series of transverse *canaliculi*, which open into the cavities of the tubes by definite *pores*, and which thus place the body-chambers of contiguous zooids in direct communication. These "canaliculi" differ structurally from the "mural pores" of the Favositidæ chiefly in being tubes with definite walls and dilated extremities, instead of being mere circumscribed deficiencies in the wall.

(4) No radiating "septa," in the form either of spines or of lamellæ, are known to exist in any species of *Monticulipora*. In *Heteropora*, on the other hand, the tubes, in the peripheral part of their course, are intersected by numerous delicate spinules, which are arranged in a radiating manner, and reach a considerable distance into the body-chamber (sometimes nearly to its centre). The spinules in form and arrangement precisely resemble the "septal spines" of many species of *Favosites*; but, admitting the Polyzoan affinities of *Heteropora*, it is obvious that they cannot be compared homologically to the septa of any Cœlenterate.

(5) Transverse partitions, or "tabulæ," are universally developed in the corallites of *Monticulipora*; and it is very common for the different kinds of tubes which make up the corallum to show marked differences in the nature and degree of their tabulation. In *Heteropora neozelanica*, Busk, tabulæ are, so far as I have seen, always present, though their number is comparatively small. They are also undoubtedly present in other species, and in greater numbers (*e. g.* in *H. conifera*, Haime, and *H. pustulosa*, Haime). So far as *H. neozelanica* is concerned, the tabulæ seem to be confined to the axial region of the corallites, and not to be developed in the interstitial tubes at all, thus differing in both of these respects from the tabulæ of *Monticulipora*. As in the case of the radiating spines, however, just noticed, if we concede the Polyzoan affinities of *Heteropora*, then the transverse partitions which cross its tubes must have a different value and import from the "tabulæ" of *Favosites* and of the so-called "Tabulate Corals" in general.

(6) Lastly, as to the supposed relationship between *Monticulipora* and *Heteropora*, and as to the deduction which has been drawn from this as to the propriety of referring the former genus to the Polyzoa, it is clear that the points of likeness between the two are by no means so weighty as the points of difference. On the one hand, we have a strong external resemblance, a general similarity in the mode of construction of the skeleton, and an agreement in the fact that in both genera the colony consists of two sets of tubes, while both have their tubes crossed by transverse partitions. Such transverse partitions of the tubes (or, as we may loosely call them, "tabulæ") occur, however, in organisms of such exceedingly diverse affinities that we can, admittedly, attach no value to the last mentioned of the above resemblances. A mere similarity in general form, appearance, or mode of skeletal conformation is also of no classificatory weight, since we could find species of *Favosites* or *Pachypora* which in these respects are quite like either *Monticulipora* or *Heteropora*; so that, after all, the resemblances between the two genera under consideration dwindle down to a comparatively small quantity.

On the other hand, to set against the mostly superficial points of resemblance above noted, we have a number of fundamental structural differences. Thus, in *Monticulipora* the walls of the tubes are imperforate, there are no traces of radiating spines or "septa," and in the dimorphic or trimorphic species there are usually important structural differences as regards the different groups of corallites. In *Heteropora*, on the contrary, the walls of the tubes are traversed by a very remarkable and exceptionally developed canal-system, the tubes possess in their outer portions a well-developed series of radiating spines arranged in vertical rows (sometimes, at any rate, if not always*), and the interstitial tubes are in no way structurally different from the proper zoœcia.

In the face of the above distinctions I feel compelled to believe, in the meanwhile, that there is no real relationship at all between *Heteropora* and *Monticulipora*. This belief would not, of course, constitute any valid ground for denying the possibility that *Monticulipora* may truly belong to the

* It is true that radiating spines have not generally been observed in *Heteropora*, and that even in *H. neozelanica*, where they are plentifully developed, they seem to have been overlooked by such excellent observers as Prof. Busk and Mr. Waters. I ascribe this, however, to their very fragile nature, and to the general neglect of *tangential* sections, in which alone they can be readily made out; and I entertain no doubt that they occur generally in the genus.

Polyzoa rather than to the Cœlenterata; and on this point I prefer at present to come to no absolutely final conclusion, though my opinions lean decidedly towards the latter as a proper resting-place for the genus. It must, however, be evident that in supporting (as many palæontologists now do) the Polyzoan affinities of *Monticulipora*, little or no weight can in future be attached to the likeness which the genus shows to *Heteropora*. It may be also pointed out that, in our present ignorance of the *animal* of *Heteropora*, it is, perhaps, not entirely without hazard that we should unhesitatingly assign *it* to a place among the Polyzoa. I do not at all overlook its resemblance to many undoubted Cyclostomatous Polyzoa, nor am I in any way prepared to deny its Polyzoan affinities; but I cannot entirely ignore the fact that the pore-canals, septal spines, and tabulæ, which are now known to exist in some species of the genus *Heteropora*, are, at any rate, as reconcilable with its reference to the Cœlenterata as to the Polyzoa.

LV.—*On the Northern Species of* Buccinum.

By J. Gwyn Jeffreys, LL.D., F.R.S.

The late Prof. Stimpson published, in the 'Canadian Naturalist' for October 1865, a "Review of the Northern Buccinums," and gave sixteen species with fifteen synonyms. Having had the privilege of examining his types, as well as those of Linné, Fabricius, Turton, Bennett, Broderip, Forbes, Möller, Hancock, Mörch, Reeve, G. O. Sars, Friele, Verkrüzen, and others, I thought a revised list of the species might be useful, and I now submit it. I recognize eight species only, with forty-six synonyms; and I believe even that number of species may be reduced when more intermediate forms are observed. Their fecundity and extensive distribution in the northern hemisphere, added to the difference in the conditions of habitat and temperature, would account for the great variability of the species. *Buccinopsis* connects *Buccinum* with *Fusus*. The generic name *Tritonium* is undoubtedly subsequent to *Buccinum*, and included *Fusus* and what I consider its subgenera, viz. *Sipho*, *Neptunea*, *Chrysodomus*, *Volutopsis*, and *Boreofusus*.

1. *Buccinum glaciale*, Linné.

B. carinatum, Phipps.
B. polaris, Gray.
Var. *B. angulosum*, Gray.